City of San Diego
Development Services Department
**Plan Review Division**
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# Building Newsletter 17-4

Requirements for
High-Strength Bolts

Interpretations of State and Local Building Codes
1994 Uniform Building Code: Chapter 17
Revision Date: January 1996

bnl 27-01/17-04



## I. Purpose

The purpose of this newsletter is to provide minimum standards for the sampling, testing and special inspection of high–strength bolts, nuts and washers.

This newsletter is not applicable to hold down anchor bolts or other applications of high– strength bolts embedded in concrete or masonry.

## II. Scope

All high strength bolts[1], carbon and alloy steel nuts, and hardened steel washers that are used for making steel–to–steel connections shall be sampled, tested and inspected in accordance with this newsletter. This includes all applications that are designated as slip–critical (SC)[1], bearing type (N or X)[1], or subject to applied tensile force.

A. Bolts, Nuts, Washers [1]

1. Bolt Specifications – Bolts shall conform to the requirements of UBC Standard 22– 1 except as provided in Section 2221.4. The designer shall specify the type of bolts to be used.
2. Bolt Geometry – Bolt dimensions shall conform to UBC Table 22–IV–F, except as provided in UBC Section 2221.4. The length of bolts shall be such that the end of the bolt will be flush with or outside the face of the nut.
3. Nut Specifications – Nuts shall conform to the chemical and mechanical requirements of UBC Tables 22–IV–G, 22–IV–H and 22–IV–I. The grade and surface finish of nuts for each bolt type shall be as follows:

| **A 325 Bolt Type** | **Nut Specifications, Grade and Finish** |
|---|---|
| 1 and 2, plain (uncoated) | C, C3, D, DH and DH3 or 2 and 2H; plain |
| 1 and 2, galvanized | DH or 2H; galvanized |
| 3 plain | C3 and DH3 |
| **A 490 Bolt Type** | **Nut Specifications, Grade and Finish** |
| 1 and 2, plain | DH and DH3 or 2H; plain |
| 3 plain | DH3 |

Nut dimensions shall conform to the requirements of Table 22–IV–J except as provided in UBC Section 2221.4.

4. Washers – Flat circular washers and square or rectangular beveled washers shall conform to the requirements of UBC Tables 22–IV–K, 22–IV–L, 22–IV–M and 22– IV–N.

## III. Sampling and Testing Requirements

Prior to installing high strength bolts within the scope of this newsletter in any structure, the bolts, nuts and washers shall be sampled and tested and their mechanical requirements verified.

A. The sampling, testing and special inspections shall be performed by a laboratory approved by this department. A list of approved testing laboratories or agencies is available upon request.

B. Identification – All bolts, nuts and washers shall be marked with a symbol to identify the manufacturers and their class, type or grade. Any piece that is not readily identifiable as to the manufacturer shall be rejected.

C. Sampling – The approved testing laboratory or agency shall take random samples of each different class, size, length, style, mechanical and chemical characteristics of bolts, nuts or washers delivered to the job. The samples shall be taken from each container as indicated in Table No. (1).

D. Testing

1. All high strength–bolt samples shall be tested for hardness in accordance with UBC Chapter 22, Division IV and ASTM[2] Standard, F606.
2. The sample assemblies (nut and bolt) shall be tested for tensile strength in accordance with ASTM Standard, F606.
   a. Wedge Tension Testing of the full size product shall be performed whenever possible per Section 3.5, F606.
   b. When full size samples cannot be tested because the required test load exceeds available testing equipment capacity the bolts may be machined and tested per Sec. 3.6, F606, with the approval of the engineer of record.
   c. When the bolts are too short to be tested per Table No. (2), the hardness tested specified in D.1 above shall be the basis for acceptance.
3. A490 heat treated high–strength bolts shall also be tested by magnetic particle method and visually inspected for longitudinal discontinuities, transverse cracks and bursts per ASTM Standard A490, Section II.

E. Approval of Results – The testing and inspection results shall be submitted to this department and the engineer of record in a clear, concise and acceptable format. If any sample fails one of the prescribed tests or inspections, then all of the product lot represented by that sample shall be rejected and removed from the jobsite. That product shall then be replaced by a

new product lot that is sampled and tested satisfactorily per this newsletter.

### IV. Special Inspection Requirements

A. In addition to sampling and testing of high–strength bolts as noted above, continuous special inspection is required while the installation of such bolts is in progress. Such inspections may be performed on a periodic basis provided this periodic scheduled inspection is outlined in the project plans and approved by the building official. UBC Sec. 2228.

B. Special Inspections must be performed by special inspectors certified by the Field Inspection Services Division of the Development Services Department, City of San Diego.

C. For additional requirements see Building Newsletter for 'Special Inspection Requirements'.

### V. Limitations

A. High–strength bolts shall <u>not</u> be installed in any connections until the required sampling and testing as noted above is completed and the results are accepted and approved by the engineer of record and this department.

**TABLE NO. 1**[5]

| Lot Size | Shipping Lot[3] Sample Size | Production Lot[4] Sample Size |
|---|---|---|
| 25 and less | 2 | 4 |
| 26 to 150 | 3 | 6 |
| 151 to 1200 | 5 | 10 |
| 1201 to 10000 | 8 | 16 |
| 10001 to 35000 | 13 | 26 |
| 35001 to 150000 | 20 | 40 |
| 150001 and over | 32 | 64 |

**TABLE NO. 2**[5]

| Minimum Length of Product Requiring Tension Testing | |
|---|---|
| **Nominal Product Size Diameter (Inch)** | **Minimum Length (Inch)** |
| 1/4 | 5/8 |
| 5/16 | 3/4 |
| 3/8 | 7/8 |
| 7/16 | 1 |
| 1/2 | 1 1/8 |
| 9/16 | 1 1/4 |
| 5/8 | 1 1/2 |
| 3/4 | 1 3/4 |
| 7/8 and larger | 3x Diameter |

**<u>Footnotes</u>:**

[1] The connection types as required by design for A325 or A490 high–strength bolts are as follows:

SC – Slip–critical connection

N – Bearing–type connection with threads <u>included</u> in shear plane

X – Bearing–type connection with threads <u>excluded</u> from shear plane.

[2] American Society for Testing and Materials

[3] A shipping lot is defined as that quantity of each different kind of bolt, nut, or washer necessary to fill the needs of a single purchase order.

[4] A production lot is defined as bolts supplied by any other means than a shipping lot. Production lot sampling will be required for all products in containers that have been opened by someone other than the laboratory representative.

[5] Reproduced from the American Society for Testing and Materials Standard Specifications.